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Building Formwork Module For Use In A Modular Concrete Formwork System

Field of the invention

The present invention relates to a building formwork module for use in a modular concrete formwork system. In one application the invention provides a method of using a building formwork module in the construction of a wall.

Background Art

In the construction of walls for residential and light industrial buildings, plastic formwork systems are generally thought not to be a suitable replacement for conventional timber and steel formwork. This arises because the size of the wall produced using a typical plastic formwork system is generally of a thickness that occupies too great an amount of space. The construction of such walls is also relatively expensive in comparison to single or double leaf brick constructions. As a consequence, prior art plastic formwork systems for concrete walls are not used on a large scale in the construction of residential or light industrial buildings, but are rather more typically used in the construction of thick walled structures such as storage tanks and industrial buildings.

When plastic concrete formwork systems are used they are commonly awkward to assemble and are limited to floor plan designs that have particular characteristics, such as particular wall lengths and cornering arrangements. The flexibility of such systems limits their application to the residential market. Furthermore, a fair amount of patience and experience is often needed in correctly aligning and positioning the formwork to receive the

concrete in producing sufficiently vertical walls. This means that the final result is often less than desirable.

While wall construction using bricks has the advantage of being able to provide for the construction of a wide variety of floor plans, the advantage is offset by the all too well known problem of periodic market shortages in both bricks and bricklayers. Bricklaying is also a relatively slow process that is often being subject to problems arising from rough and haphazard workmanship. A further problem of some types of brick wall is lack of strength caused by using hollow core bricks and blocks.

Precast concrete wall construction, on the other hand, has the disadvantage of not being flexible and therefore not being suitable for residential housing.

Thus, it would be advantageous if a relatively flexible and convenient formwork system for concrete wall construction could be provided that is suitable, among other things, for use in the construction of residential houses. As will become apparent the invention will find application in other areas.

It is against this background and the problems and deficiencies associated therewith that the present invention has been developed.

Disclosure of the Invention

According to a first aspect of the invention there is provided a modular formwork system comprising:

a plurality of building formwork modules, each module being able to accommodate wall forming material such that the wall forming material is able to solidify in the module and thereby provide a rigid module; and

a spacer comprising a body portion during use between adjacently disposed formwork modules so as to retain the spacer relative to the formwork modules during use, and a first projection, the first projection extending beyond the formwork modules when the body portion is disposed during use between adjacent formwork modules, and the first projection including first mounting means spaced from the building modules.

Preferably the building formwork module includes two lateral sides connecting the faces and spaced either side of the web so as to define the two channels with the web and the faces.

Preferably the building formwork module is formed as an integral, whole for most purposes so that the unit is readily handled and transported around a worksite.

The unit may be extruded from plastic such as PVC to form the web and the two channels. In this manner a number of modular units can be relatively economically produced for use in a modular formwork system. The channels may also used to create capping formwork and base formwork fixed to the floor. The modular units preferably fit the capping and base units.

In some arrangements a module may include more than one web and more than two channels.

The web may be spaced midway between each lateral side and the two channels may be square in cross section. Preferably the widths of the first and second -faces are equal, being about twice the width of each lateral side. The widths of the module may be somewhere between one half and a full standard brick's width. Preferably multiples of the widths of the module should equal common dimensions used in the building industry.

Preferably the lateral sides are suitable for abutting against the lateral sides of other building formwork modules, and the lateral sides include a plurality of aligned flow holes such that when one of the lateral sides of the building formwork module is abutting in aligned relationship with the lateral side of another building module having corresponding flow holes, wall forming or concrete material is able to flow through the flow holes from the building formwork module into the other formwork module. The web may include flow holes allowing the wall forming material to flow between the channels of the building formwork module.

The modules may be configured to prevent the penetration of water by making the water follow a tortuous path. In addition the joined surfaces may be configured to allow the easy and economical use of sealants.

The system may include a brace arrangement comprising a first brace member and a second brace member for defining a brace channel in which the building modules are to be held from top portions thereof in vertical alignment during the construction of a wall, the brace arrangement being arranged to hold the modules such that a length of the wall forming material solidifies within the brace channel. The length preferably forms a continuous ring beam.

In one preferred arrangement the system includes means for attachment to the brace arrangement and a support tower, the means being selectively operable to move the brace arrangement in a horizontal plane substantially aligned with the ground on which the support tower rests. The means for attachment may be used to accurately define the absolute height of the wall.

According to a second aspect of the invention there is provided a method of constructing a wall using a modular wall forming material formwork system including: holding a brace arrangement above the ground, the arrangement providing a channel in which a plurality of building formwork modules can be received; inserting modular formwork modules into the channel such that they extend from the ground in accordance with a floor plan, each of the modules having a first face and a second face which are connected by a web; the faces and web of each module defining two channels that extend along the longitudinal length of the module ; pouring wall forming material through the brace arrangement such that the wall forming material flows and fills the modules and reaches and hardens within the channel forming by the brace arrangement; and allowing the wall forming material to harden to a sufficient strength to form the wall.

The method may further include inserting steel reinforcing rods into holes in the modules before the wall forming material is poured through the brace arrangement.

It will be seen than embodiments of the invention provide for building formwork modules that are readily handled and transported around a worksite as an integral unit. The units do not need to be individually assembled when abutting the lateral faces of the units against one another for subsequent filling with concrete. The method of construction means that the slow and tedious process of laying bricks in single or double leaf is avoided. Exterior material surfaces can be applied to provide improved insulation and the appearance of a conventional house. The accuracy of the positioning of the walls is also tightly controlled so as to provide aligned, well dimensioned, and vertical walling suitable for use with plaster sheeting and other commonly used interior and exterior cladding materials.

Further insight into the aspects, advantages and characteristics of the present invention can be gained from the specification as a whole including the following description of preferred embodiments.

Brief Description of the Drawings

The invention will be better understood by reference to the following description of several specific embodiments thereof, as shown in the accompanying drawings in which:

Figure 1 is a perspective view of a modular formwork module used in a modular -formwork system according to a first embodiment;

Figure 2 is a perspective view of the portion marked "A" in Figure 1;

Figure 3 is a perspective view of a spacer module included in the first embodiment;

Figure 4 is a perspective view of a modular formwork module as shown in Figure 2 together with a spacer module as shown in Figure 3, a number of which spacer and formwork modules are included in the first embodiment;

Figure 5 is a perspective view showing how the spacer module of Figure 3 is used to provide an interior wall;

Figure 6 is a view similar to Figure 3 except that the spacer module shown is employed in the construction of an external, rather than internal wall ;

Figure 7 is a perspective view of a modular formwork module forming part of a second embodiment of the invention;

Figure 8 is a perspective view of a formwork system showing a number of modular formwork modules as shown in Figure 3 engaged with a spacer module, each of the modules forming part of the second embodiment;

Figure 9 is a perspective view of a modular formwork module according to a third embodiment;

Figure 10 is a sectional view in elevation of an interior wall formed according to yet another embodiment of the invention ;

Figure 11 is a sectional view in elevation of an exterior wall formed according to another embodiment;

Figure 12 is a fragmentary partial view of a formwork system according to a further embodiment of the invention;

Figure 13 is a perspective view of a formwork module. used in the embodiment shown in Figure 11;

Figure 14 is a fragmentary partial view of a formwork system according to yet another embodiment;

Figure 15 is a perspective view of a variable width spacer module according to a further embodiment;

Figure 16 is a schematic front view of formwork system according to a final embodiment, the embodiment employing a variable width spacer module.

Best Mode(s) for Carrying Out the Invention

A first preferred embodiment of the invention is described with reference to Figures 1 to 6. The embodiment comprises a modular formwork system 10 having a plurality of building formwork modules 12, one of which is shown in Figure 1. The formwork system 10 is used in the construction of both internal and external walls for residential houses. The system could also be employed in other applications.

Each of the building formwork modules 12 comprises a lightweight plastics moulded building module, or unit, having a first face 14 and an opposite second face 16. Two lateral sides 18 and a web 20 are arranged so as to extend between the first and second faces 14,16 such that the faces 14,16, the lateral sides 18 and the web 20 define a first channel 22 and a second channel 24, both of which extend along the longitudinal length of the module 12. The first and second channels 22,24 are able to accommodate

superfluidised concrete in that the concrete is able to be poured into the two channels 22,24 and settle therein.

The concrete can be varied in its specification according to whether strength, flow or insulating qualities are required. The use of aerated concrete is envisaged in circumstances requiring a high level of insulation.

The web 20 in the module 12 provides the module 12 with a rigidity that maintains a relatively flat outer surface 26 on the first side 14 of the unit 10, against what would be the pressure applied by the superfluidised concrete as it solidifies within the two channels 22,24. By having module 12 formed from plastics material such that the web 20 provides two channels of sufficient rigidity, the embodiment is able to provide a readily handled unit that facilitates the construction of a variety of walls according to a wide variety of floor plan characteristics, that are commonly used in and exhibited by residential buildings.

Importantly, the provision of a flat outer surface 26 on each of the modules 12, once the concrete has hardened, ensures that the wall formed can have sheeting or tiles readily applied to its surface. The wall formed is of a high quality finish and is only offset from vertical by the smallest of margins and can be constructed to the correct horizontal alignment.

One of the advantages of the embodiment described with reference to Figures 1 to 6 is that the faces 14,16, lateral sides 18 and the web 20 can be formed by an extrusion moulding process in which each of those integers are formed in one action. This means that the web 20 does not have to be affixed between the faces 14, 16 at a later time, and that the basic form of the module 12 can be mass produced. In other arrangements the extrusion moulding

process can also be used to produce the channels without the web.

Referring now to Figure 2, it can be seen that the lateral sides 18 and web 20 include a number of flow holes 28. The flow holes 28 are drilled through the modules 12 after the modules have been produced using the extrusion moulding process. This is performed with a specially designed drilling machine. It is envisaged that high pressure water cutting machinery or laser cutters would be suitable.

The web 20 is spaced midway between the lateral sides 18 and the two channels 22,24 are square in cross section. This makes it easy to abut the lateral sides 18 of a number of formwork modules 12 one against the other in series relationship.

To provide a wall of sufficient strength it is advisable that the width of each lateral side is somewhere in excess of 50mm as the concrete may need a minimum width of 50mm a height to thickness slenderness ratio of 50: 1 cannot be exceeded. These values are dependent on the type of concrete used as well as the overall arrangement.

Given that the channels 22,24 are square in cross section this means that the thickness to width ratio of each module 12 is about 1: 2. For sufficient strength, reinforcing steel bars may have to be used. This is described in the following paragraphs with reference to Figure 10.

The flow holes 28 in each of the modules are aligned such that when the lateral faces 18 of two modules 12 are abutted one against the other, such that each of the four cavities 22,24 of the modules 12 are aligned one after the other in series relationship, concrete is able to flow through the flow holes 28 between each of the modules 12.

As can be seen in Figure 2 the web 20 also includes a number of flow holes 28 so that concrete is able to flow between channels 22, 24 in the module. The flow holes 28 in the web 20 do not need to be aligned because those flow holes are not for abutting against other flow holes. However, for the reasons of both simplicity of construction and to facilitate reinforcement of the interlocked concrete core with steel bars, it is envisaged that the flow holes 28 in the web 20 are aligned with the flow holes 28 on the lateral sides 18. The flow holes are aligned in the embodiment shown.

By virtue of flow holes 28, wall forming material that has hardened in two adjoining modules 12 will form a continuous interlocked structure. To improve the strength of the structure, steel reinforcing bars are fed through the flow holes 28 in a repeating fashion as well as longitudinally through a number of the channels 22, 24 of the modules 12. As noted the flow holes 28 in the web must be substantially aligned with the flow holes 28 on the lateral sides 18 of each module 12 for this to be possible.

To form a wall of substantial thickness flow holes may be present on one of lateral face 14 or lateral face 16 such that lateral face can be abutted against a similar lateral face of another module 12. In this manner two rows of modules 12 may be run next to each other with abutting lateral faces having corresponding flow holes such that an interlocked wall of twice the thickness of one of modules 12 can be formed. Other arrangements are of course possible.

The formwork system 10 includes a number of spacer modules, one of which, namely spacer module 30, is shown in Figure 3. The spacer module 30 includes a first side 32 and a second side 34. The first side 32 includes a cavity

36 and the second side includes a oppositely directed cavity 38. The cavities 36 and 38 are adapted to receive a lateral face 18 of two corresponding modular building modules 12 along their length. When the modules are received in the spacer 30 they are to be taken as being abutted against each other. In Figure 4 one building module 12 is received in cavity 38 while cavity 26 has been left vacant. Another module 12 is still to be received within cavity 36.

As is evident from Figure 4, the cavities 36,38 are arranged to provide a concrete core having a width of the size of the each of the channels 22,24. In this case the thickness of module 12 and each channel 22, 24 is 75mm. The spacer 30 includes a number of flow holes 40.

The module 12 is longitudinally received in cavity 34 such that the flow holes 40 in the spacer 30 are aligned with the flow holes 28 in the module 12. This allows for concrete to flow though the spacer 30 from a module 12 received in cavity 36 to another module 12 received in cavity 38 and for reinforcing steel to be threaded through.

The spacer 30 includes two flanges in the form of a first flange 42 and a second flange 44. Each of the flanges 42, 44 extend past the cavities 36,38 in a direction substantially perpendicular to the direction of the cavities 36, 38. The first flange 42 includes a mounting means in the form of a first flange extension 46 which extends a direction substantially parallel with the direction of the two cavities 36, 38. This allows for a first planar sheet 48 to be mounted onto the spacer 30 as shown in Figure 5.

In a similar fashion the second flange 44 includes a second flange extension 50 that extends in the same

direction as the first flange extension 46. This allows for a second planar sheet 52 to be mounted onto the second flange extension 50. The mounting of the first and second planar sheets 48,52 to the flange extensions 46,50 provides a facade or covering on both sides of the wall provided by the modules 12. With the use of two flanges 42,44 gaps 54 and 56 are provided on either side of the modules 12. These gaps may be left vacant or may be filled with insulating material such as fibreglass. For internal walls no insulation is used and voids are only used for wiring and piping.

The spacer module 30 shown in Figures 3 and 4 is intended for use in the construction of an internal wall. Once the planar sheets 48 and 52, which in this case are 10 mm plasterboard, have been mounted to the spacer module 30, and the other spacer modules, they provide a finely finished surface.

In this arrangement the air gaps 54, 56 are 25mm wide, the concrete core is 75mm wide and the plasterboard is 10mm wide. With the combined use of reinforcing rods such an arrangement provides a high thermal mass having good strength characteristics.

The 25 mm air gap provided facilitates the later addition of water pipes and wiring, which are be fixed to the wall surface after construction. After this the pipes and wiring are covered with the plasterboard 48,52. If the pipes or wiring have to extend horizontally then holes in the plane sheeting are drilled or cut to provide access.

A spacer module 58 used for external walls is shown in Figure 6. The spacer module 58 provides a wider air gap on the side of each of the modules 12 that is exposed to the external elements. For this reason a flange 60 is provided that extends further past the cavities 62, 64 than flange

44 extends past cavities 36, 38 in the case of an internal wall. The spacer module 58 in alternate embodiments is integrally formed with a building module 12.

One of the benefits of the formwork system 10 is that the modules 12 substantially encase the concrete so as to limit the ability of water to penetrate into or through the structure. It is recognised that some water may penetrate between the modules 12 deviating around the interlocking concrete connections provided by the flow holes 28. To limit this effect a number of alternate embodiments have been devised. These embodiments are now described, firstly with reference to Figure 7.

In the arrangement shown in Figure 7 the abutment of the lateral sides of the building modules 12 is controlled with the use of a male and a female lateral side. Thus, in module 62, which has a first lateral side 64 and a second lateral side 66, the first lateral side 64 includes a male mating section along the length of the spacer while the second lateral side 66 includes a female mating cavity into which a male mating section of a second module 64 is received.

As can be seen from Figure 8 this does not mean that a spacer module of a different configuration to that of spacer 30 must be used for mounting plasterboard as previously described. Rather the use of a spacer module 68 having oppositely directed but otherwise identical cavities 70, 72 means only that the building modules 62 are rotated 180 degrees in the procession of modules 62 at the spacer 68, when arranged to receive concrete.

With the use of modules 62, water penetrating between the modules has to undergo a more tortuous path than would be the case with modules 12, which were described in relation to the first embodiment.

Another embodiment that may suitably prevent the penetration of water from one side of a formwork module to another is shown in Figure 9. In this embodiment a number of unusually shaped flow holes are provided. Water penetration is limited by each of the flow holes that is beneath another flow hole (the upper flow hole) being provided with an apex that reaches the lowermost portion of the upper flow hole. As can be seen from the Figure 9 the apex 82 of flow hole 80 is at the same level as the bottom 84 of flow hole 76.

As a consequence water moving directly across the building module will have to contact concrete at some stage. Of the flow holes shown, flow holes 76 are the largest and are the only holes shown that are shaped to receive a steel reinforcing rod.

Referring to Figure 10 there is shown an interior wall 90 formed according to yet another embodiment of the invention. In this embodiment the interior wall is constructed by fixing a channel 92 and starter bars (not shown) to the floor of a concrete slab 97. Following this a brace arrangement 94 having a number of holes 96 in its top is placed and held over the channel 92. A number of formwork modules 12 are subsequently stood vertically in the channel 92 and fed into the brace arrangement 94 so as to reside in a channel 98 thereof. A number of spacer modules 30 are disposed between the modules as previously described. The starter bars (not shown) are received within a number of holes 93 drilled into the concrete slab 97.

Once the modules 12 are correctly aligned, concrete is poured though the holes 96 in the brace arrangement 94 so as to fill the building modules 12, which as before, have flow holes 28 to ensure that a solid wall is formed. The

spacers 30 provide an air gap 100 to the left of the building modules 12 and an air gap 102 to the right of the building modules 12. Each of the spacers 30 provide flanges 104, 106 that provide surfaces onto which plaster board sheets 108,110 are mounted. Steel, timber and fibre cement sheeting may be used instead. The flanges 104, 106 do not extend all the way to the top, or to the base of the modules 12. This provides room for the brace arrangement 94 and the channel 92. A run of removable skirting 112 is provided below the plaster board sheets 108,110 to allow for computer and electrical cabling to be run along the wall, and more importantly, to be readily accessible.

The channel 92 in this arrangement is formed from plastic, although the channel 92 could, like the brace arrangement 94, be made from PGI steel.

Figure 11 shows an exterior wall arrangement, which has a noticeably longer flange 114 that extends to an outer layer of exterior cladding 116. The outer layer of exterior cladding, rather than being plasterboard can be autoclaved aerated concrete panels, fibre cement sheeting, steel cladding, timber, stone blocks for brick walling. This allows for the wall to present a face that fits in with the rest of the surroundings or neighbourhood. To provide improved insulation an inner layer of insulation 118 occupies part of the gap provided by the flange 114. The insulation 118 is spaced on either side of the flange 114.

In this particular arrangement air gap 119 is 75mm in wide with a 55mm layer of reflective insulation disposed therein. This leaves a 20 mm air gap which is followed by the cladding.

In practice it can be difficult in keep the modules 12 vertical whilst the concrete is being poured and also during subsequent hardening. To provide the wall with sufficient verticality the positioning of the brace arrangement may have to be readily adjustable. One formwork system 120 providing such adjustability is shown in Figure 12. The formwork system 120 includes a number of building formwork modules 122, a number of spacer modules 124, a channel 126 for holding the modules 124 in alignment along a concrete slab 128, and a brace arrangement 130 for ensuring that the modules 112 are held in vertical alignment. The brace arrangement 130 includes a first brace member 132 and a second brace member 134 which together define a channel 136. The position of the channel 136 is controlled using an adjustor 140 and an adjustor 142. The first and second brace members 132,134 are held together using abo ! t arrangement that comprises a plurality of bolts 138. Additional stiffness can be obtained by clamping a yoke (not shown) to the top surfaces flanges 155 of brace members 132,134.

A number of PVC sleeves 141 in the channel cover the bolts 138 such that the bolts 138 can be easily removed with the brace arrangement 130 once the concrete has solidified.

In this embodiment there is included a further brace 127. This brace 127 functions in a manner similar to brace 94 described in relation to the embodiment shown in figure 10. It is envisaged that brace 127 will in other embodiments be spaced above the top of modules 122 such that a continuous concrete beam is formed below the brace 127, between the brace 127 and the modules 122. In these embodiments the brace 127 may be fixed to the modules 122. Formation of a continuous concrete beam in this embodiment is described below.

Each of the adjusters 140,142 includes a number of nuts 139 that are welded to the second brace member 134. Two threaded members 144,146 are threaded through the nuts 139 and are connected one end to a support structure or scaffold arrangement (not shown). By rotating the threaded members 144,146 the brace arrangement 130 can be positioned to dispose the modules 122 in a sufficiently vertical configuration.

The scaffold comprises a right-angled triangular base with a web at each corner. The three webs are screw fixed to the ground slab at fixed offsets to the channel 126.

The bolts 138 that keep the first and second brace members 132,134 together are tightened using rather large hand tightenable wing nuts 148. The nuts 148 are tightened after the modules 122 have been received in the brace channel 136 so as to keep the modules 122 in position, abutting against one another. The nuts 148 are tightened so that a modicum of pressure is applied to the lateral sides and webs of the modules 122. Once the modules 122 are firmly in position reinforcing rods 150 are inserted through the flow holes 152 in each of the modules. A number of reinforcing rods 154 are also placed in the longitudinally extending cavities of the modules 122. The brace 127 assists with locating these rods. Receiving holes (not shown) are drilled into the concrete slabs 128. The brace 127 is used for straight runs and butts against the brace members 132, 134.

After all of the modules 122 are in position concrete is poured into the channel 136 such that the formwork of modules 122 and channel 136 is filled with concrete. A funnel may be used for this purpose.

After the concrete has solidified the concrete in the channel provides a continuous -concrete ring beam that

serves to further interlock the concrete that has solidified in the modules 11. In this arrangement the brace arrangement 130 is removed from the final concrete structure to reveal the ring beam, which can be used to support a plate for roof trusses as is common in the trade. Alternatively a suspended slab can be constructed on top of the ring beam.

The plastic sleeves 141 make removal of the brace arrangement relatively easy. The nuts 148 are untightened, the bolts 138 withdrawn from the sleeves 141, and the first and second brace members are removed from the concrete.

If the first and second brace members 132, 134 need additional reinforcement then a metal yoke can be affixed to the upper flanges 155.

At the corner of the wall a special module 122 must be used to prevent concrete flowing out of one of the lateral sides. Figure 13 shows such a module 122.

The module 122 comprises a first face 158 and a second face 160 as before, however rather than the far lateral side 162 containing flow holes, flow holes are provided on the far half of the second face 160. Concrete is therefore forced to flow along the path marked "A" in the Figure. Concrete will also flow along the channels of the module 122 however this is not shown for reasons of clarity. Alternatively flowholes can be closed off using formply screw fixed to the plastic formwork.

If module 122 were to be used for a T section at the interface of say an external and internal wall, then flow holes would also be provided on lateral face 162. To form a T join at an external wall three modules 112 should be used, one of which is the special T module arranged such

that it extends perpendicularly to the other two modules from a position therebetween. By having the T module as part of both connecting walls the join is further strengthened. The embodiment accordingly provides for flexibility that is not otherwise provided by prior art formwork systems.

Referring to Figure 14 there is shown yet another embodiment of the invention having a clip arrangement 172.

The clips 172 are used to keep the modules 170 abutting against one another. Although not shown for reasons of clarity the modules 170 are clipped at both the top of the modules 170 and at the bottom of the modules 170. "T" and 90° connections can be made by clipping either faces 16 or 12 or to a face 18.

In the construction of a house centre lines for all the proposed walls are marked on a ground slab. To facilitate the location of the support structures, offsets to the centre lines on the ground slab are marked at each location where a support structure is to be positioned. The U channel is fixed over the centrelines using holes in the channel. The scaffold support structures are positioned and bolted to the ground adjacent the corners as appropriate and construction is begun by forming the walls corner to corner until all the inner and outer load bearing walls have been formed. A roof or upper wall slab is secured to the ring beam provided and wall plumbing and electrical wiring are mounted to the wall. The plasterboard surfaces are then applied to cover the plumbing and electrical wiring and to present a vertical smooth surface for subsequent finishing.

There will be occasions where a variable width building formwork module is required. Once such module 176 is shown in Figure 15. The module 176 comprises a first U section

178 and a second U section 180. The first U section 178 is telescopically received within a cavity 182 of the second U section 180. The arms of the U sections 178,180 overlap and are moveable such that the width of the module 176 can be varied. This allows for walls of varying lengths to be constructed, a feature that is not provided by most if not all prior art modular concrete formwork systems known to the applicant. Overlapping tabs 186 on each of the U sections 178,180 provide a number of flow holes 184. The overlap can be screwed or covered with formply held by screws if necessary.

The module 176 includes a web 187 that is shown in phantom for reasons of clarity.

Embodiments of the invention may be arranged to accommodate windows and doors. Once such arrangement 188 is shown in Figure 16. The arrangement 188 -makes use of a number of modules having flow holes indicated by the arrows in the Figure. Where arrows are not present it is to be appreciated that there are no flow holes. Of particular mention is module 190, which is used to allow for the accommodation of a window of any length. Furthermore special lintel support beams 192 having reinforcing steel therein (not shown) are used to ensure that the window is not subject to any vertical loads. The tubes beneath the window, that is tubes 194, are cut to length as required. It is noted that with the variable length tube it is important that concrete flows from the lateral side of the tube that will force the telescopically received U shaped sections apart rather than together. If clips are used so join the building modules together then this problem is obviated. Additional strength and details such as window sills can be created by fixing formply to the surfaces of the formwork 194.

Thus it will be seen that embodiments of the invention can provide for a flexible formwork system comprising a number of rigid plastic concrete modules that abut against each other. Each of the modules includes a number of flow holes that accommodate reinforcing bars and allow for the formation of and interlocked concrete core. By virtue of the plastic formwork covering the concrete core moisture penetration into the concrete, which is in comparison quite porous, is limited. The modules are relatively light weight, are easily handled on site, and provide for a relatively flat exterior surface. The system allows for rapid wall construction obviating the tedious task of brick-laying. Accurate vertical surfaces are produced with the use of the brace and support system and flexibility is achieved so that walls can be constructed to a number of conventional wall plans.

The incidence of cracking in all surfaces will be substantially eliminated and conventional stresses associated with reactive soils are correspondingly thought to be comparatively less damaging.

As for noise, the walls are much denser then hollow core brick so as to substantially reduce airborne sound propagation. The voids created in completed wall will absorb impact noise. Penetration of water by osmosis or capillary action is reduced in comparison to penetration that occurs with a layered construction of-brickwork. In terms of the alignment, the embodiments described provide for good verticality and horizontal alignment.

Furthermore the interlocked concrete core provides the wall with a high thermal mass which in combination with wall cladding provides for relatively superior insulation. Thus the energy efficiency of a residential house constructed according to the embodiments described is expected to be considerably better than conventional

residential houses. To date a plastic formwork arrangement that is capable of producing such energy efficiency while still producing walls of suitable thickness is not available. The embodiment described fulfils a long felt need.

It is considered that a single level house can be built more rapidly than with conventional brick. Standard doors, windows, wall claddings and conventional building materials are compatible with the preferred embodiments.

Whilst the construction of a one storey house has been described, the construction of a two storey houses will also be possible. A suspended slab would in one embodiment be rested on the ring beam and the second storey built up therefrom. The invention may also be used to construct load bearing walls for industrial and commercial buildings, apartments and retaining walls.

It will be understood that various changes may be made to the form, details, arrangement and proportion of the various parts and steps without departing form the spirit and scope of the invention. Modifications and variations such as would be apparent to the skilled addressee are, at the very least, considered to fall within the scope of the present invention, of which the preferred embodiments described herein are specific examples.

Throughout the specification, unless the context requires otherwise, the word "comprise" or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.